US Army Corps of Engineers.
Construction Engineering Research Laboratory

Fact Sheet

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BIOLOGICAL SOIL CRUSTS FOR ARID LAND REHABILITATION

The Problem

Over 70% of all Department of Defense lands are in the semiarid and arid regions of the United States. Given the locations of recent and potential international military conflicts, there is an increasing priority for the U.S. military to use these lands for training and testing. Sustainment of stable, realistic training and testing environments in arid and semiarid landscapes is vital to national security and maintenance of military readiness. However, these lands are characterized by low rainfall, unpredictable spatial and temporal precipitation patterns, dramatic temperature fluctuations, sparse vegetation, and high solar radiation. They are especially susceptible to damage from military activities and natural recovery is very slow.

Public perception of arid and semiarid lands has also shifted. Although traditionally viewed as less habitable and, therefore, more acceptable as sacrifice areas, public sentiment toward arid ecosystems has shifted toward environmental accountability and habitat protection. Once thought to be sterile environments, deserts are now known to provide refuge for endemic biodiversity, sensitive habitats and endangered species. In addition, clean air regulatory mandates have identified arid areas as sources of unacceptable levels of dust.

The Technology

In semiarid and arid areas, soil microphytes (microscopic algae, cyanobacteria, lichens, mosses, etc.) have evolved to fill many of the ecological niches performed by vascular plants in more mesic regions. Of particular note are their roles in soil stabilization and nutrient cycling. Many of these organisms form microscopic fibers and secrete polysaccharide compounds that bind surface soil particles into stable biological soil crusts that are very resistant to wind and water erosion. Nitrogen fixation by crust organisms, particularly cyanobacteria, is often a significant source of nitrogen in deserts. Biological soil crusts are also linked to cycling of other essential elements. As a result, the germination, establishment and nutritional composition of vascular plants can be greatly affected by the presence of the crusts.

Researchers at the US Army Construction Engineering Research Laboratory (CERL), in collaboration with scientists from John Carroll University, Brigham Young University and the U.S. Forest Service, are developing techniques to use biological soil crust organisms in rehabilitation prescriptions for arid and semiarid lands. Live cultures of several species of cyanobacteria have been pelletized in an alginate matrix. When applied to disturbed soils, the pellets have been shown to significantly increase the cyanobacterial population, nitrogen fixation, and infiltration of rainfall into the soil.

Benefits/Savings

The economic benefits to the military of using biological soil crust organisms for land rehabilitation are difficult to quantify. However, reestablishment of biological soil crusts following

disturbance represents our best and most economical alternative to maintaining and rehabilitating disturbed arid lands. The alternatives of “pave the desert”, “irrigate it”, or “sacrifice it” are unacceptable.

Status

While significant strides have already been made, research continues. Study plots were established in 1992 at Dugway Proving Ground, UT; during 1995 at Yuma Proving Ground, AZ, Fort Bliss, TX, and the San Rafael Swell, UT; and during 1998 at Ft. Irwin, CA. The effects of cyanobacterial pellet application are being monitored on plots that were previously trampled or burned. To date, the results are promising.

Point of Contact

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